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Title: QAPP Addendum

Date: March 13, 2020

Revision 2

Site Name: United Shoe Machinery Division North Parcel

Site Location: 181 Elliott Street, Beverly, MA

Form A: Title and Approval Page

**Quality Assurance Project Plan Addendum for United Shoe Machinery Division North Parcel,
Beverly, Massachusetts**

Document Title

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FSL Associates, Inc.**

Prepared By

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Address and Telephone Number

March 13, 2020

Date

Project Coordinator:

Signature

Gregory Flaherty
Printed Name/Date

Project Manager:

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Project QA Officer:

Signature

Ron Tiberi
Printed Name/Date

U.S. EPA Project Manager Approval: _____

Signature
Sebastian
Rodriguez
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Form B: Project Organization and Responsibility

The following chart presents the organizational structure for this project.

Cummings Properties, LLC Project Coordinator: Gregory Flaherty will coordinate project phases and schedules, arrange support services, and track overall project progress. The coordinator, along with Cummings Properties, LLC's Corporate General Counsel will serve as a liaison between EPA and the primary site assessment contractor.

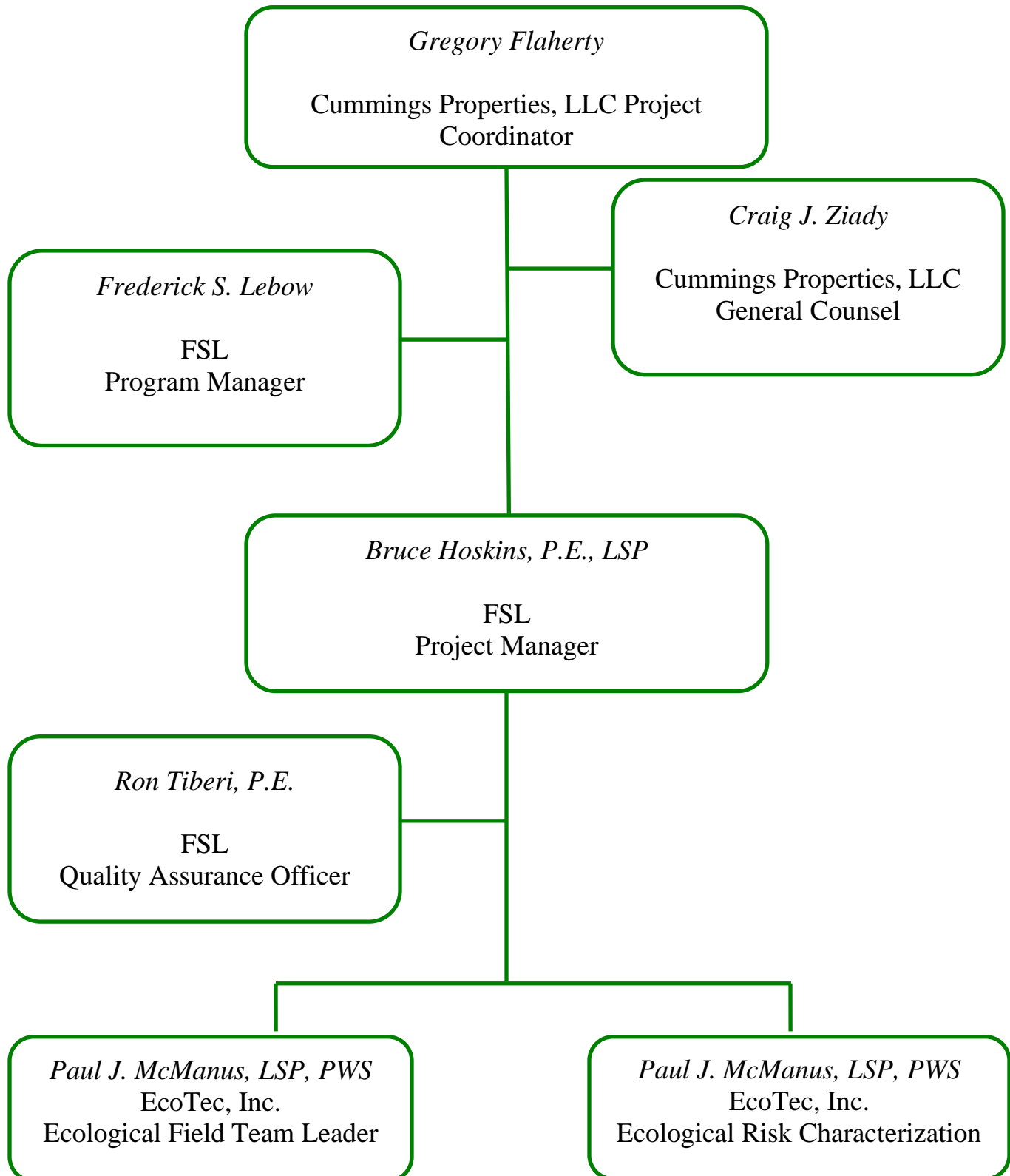
FSL Project Manager: FSL Associates, Inc. (FSL) will be conducting the Site assessment activities of this project. The FSL Project Manager, Bruce Hoskins, will provide overall direction to the field investigation.

FSL Program Manager: The FSL Program Manager, Frederick Lebow, will oversee FSL activities and provide senior review where necessary.

FSL Quality Assurance Officer: FSL's Quality Assurance (QA) officer, Ron Tiberi, will be the QA Officer responsible for this project. The QA Officer reports independently to the FSL Corporate Manager, and hence, has full authority to act independently from the technical line management structure. He will monitor compliance of the project with this plan, and perform any necessary performance or system audits. FSL's QA Officer will initiate and monitor any necessary formal corrective actions. He will assist in preparing QA/Quality Control (QC) project summaries for the final report, including analysis of precision, accuracy and completeness of data collected.

Ecological Field Team Leader: A Field Team Leader will be in charge of the field investigation. The Field Team Leader, Paul J. McManus of EcoTec, Inc. will prepare for field activities and conduct investigations. He will be on Site to: 1) ensure that required QC procedures are followed for sample collection; 2) initiate informal and/or formal corrective actions, as necessary; and 3) maintain and report QC records (i.e., chain-of-custody). This individual reports to the FSL Project Manager. He will also conduct the ecological risk assessment.

ORGANIZATIONAL CHART



Form C: Problem Definition

The former United Shoe Machinery (USM) Division North Parcel consists of approximately 80 acres at 181 Elliott Street in Beverly, Massachusetts. A Locus Plan is shown as **Figure 1** and a Site Plan as **Figure 2**.

The facility operated as USM from 1905 to 1987 and was used primarily to produce shoe manufacturing machinery. On-site heavy operations involved metal casting, forming, and machining. Various petroleum products, solvents, and paints were historically used. Support activities for manufacturing operations included burning of coal and fuel oil for power generation, recirculation of water from the Lower Shoe Pond for powerhouse cooling, pumping of water from the Upper Shoe Pond for nonpotable purposes, and construction of cinder track beds for rail transport. Pond sediments from both ponds were periodically dredged and placed as fill on-site in the former ball field area.

The USM business was purchased by Emhart Corporation (Emhart) in 1976. In 1987, Emhart sold the shoe machinery business to Ablekind Ltd. of Great Britain, which moved equipment from the facility while Emhart retained the property. Property use between 1987 and 1996 was for storage and light industry by a number of tenants. The property was sold to Beverly Commerce Park in 1996, which redeveloped the Former USM Machinery Division North Parcel (Site) into the current Cummings Center. Current uses of the Site include office, retail, and commercial use, as well as child day care and school facilities.

Cummings Center (Former USM Machinery Division North Parcel) is a subset of the entire property that was the Former USM Machinery Division. There is also a South Parcel of the Former USM Machinery Division which is located on the south side of Elliott Street (Route 62). Environmental response actions at the Former USM Machinery Division property have been performed under the requirements of the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000. The property was reported to the Massachusetts Department of Environmental Protection (MADEP) in 1989. Extensive environmental site characterization occurred at the property from 1987 to 1990 with samples collected throughout the property primarily relating to soil and groundwater, but samples of surface water and sediment at the Upper and Lower Shoe Ponds (located on the property) were also taken. Samples were analyzed for total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and metals. Sampling strategies and results are documented in "Phase II – Comprehensive Site Assessment, United Shoe Machinery Facility, Beverly, Massachusetts" by Haley & Aldrich, Inc., June 1991. As described in the Phase II report, soil samples from across the facility contained detectable levels of metals, VOCs, SVOCs, and TPH. PCBs were detected in only a limited number of soil samples and typically at concentrations less than 1 parts per million (ppm), although elevated PCB concentrations were detected in some of the excavated soil stockpiles. The majority of groundwater samples from across the Site did not contain VOCs, PCBs, or SVOCs, but did typically contain some metals and TPH at low concentrations.

The Phase II report references a separate human health risk characterization report (“Phase II Risk Characterization for the USM Site” by Cambridge Environmental Inc., June 1991). Results of the risk characterization indicated that, for most of the USM facility, risk estimates were below the MCP risk criteria. The risk characterization was performed using an unrestricted use scenario (i.e., residential use) and identified possible future risk at the following five property locations (as shown in **Figure 3**):

- Chip Grind Shed Area – Primary contaminants of concern identified as TPH and PCBs
- Chip Storage Shed Area – Primary contaminants of concern identified as TPH and PCBs
- Area 2.8 – Primary contaminants of concern identified as TPH and naphthalene
- West Parking Lot “Hot Spot” – Primary contaminant of concern identified as lead
- Ball Field “Hot Spot” – Primary contaminant of concern identified as TPH

SVOCs in soil were the primary contaminants contributing to the risk. Groundwater risk was not quantified at that time as the groundwater concentrations were compared to drinking water standards, which were not considered to be applicable at the Site. The Site is not located in a drinking water resource area.

A Phase III Final Remedy Response Plan was completed in August 1992 by Haley & Aldrich. As future property development plans were for commercial use and did not include residential use, the Phase III report developed a remedial plan based on a restricted commercial use scenario. Under this scenario, soil remediation by excavation and on-site cold-mix batching or off-site disposal was selected as the remedial alternative. Soil remediation took place at the locations identified above. No groundwater remediation was included in the remedial plan as the groundwater was not used for drinking water purposes.

In April 1996, an Activity and Use Limitation (AUL) was placed on the entire Northern Parcel property to prohibit future residential Site use and limit Site use to commercial and industrial uses. As part of the AUL, use of the on-site ponds was restricted to prohibit recreational uses such as boating, swimming, and fishing.

Soil remediation occurred from October 1996 to July 1997 and is documented in the report “Phase IV Final Inspection Report” by Haley & Aldrich, October 1997. The primary locations of soil remediation are shown in **Figure 3**. The soil remediation goals were those as established by the MCP for non-residential use. These included a soil remediation goal for TPH of 10,000 ppm, a PCB goal of 2 ppm, and a goal for lead of 600 ppm. Confirmatory samples collected during soil remediation documented successful achievement of these goals. Sample results are included in the Phase IV report. No groundwater remediation was performed as it was deemed not necessary based on the MCP risk assessment protocols applicable at that time. This conclusion was based on the original 1988 Phase II sampling. Oil non-aqueous phase liquid (NAPL) was encountered during the soil excavation of the area known as the former Chip Grind Shed. The NAPL source was

believed to have been from oil in abandoned utility lines from the adjacent Powerhouse (now known as Building 900).

After the completion of the remediation documented in the Phase IV report, the North Parcel property was closed with a Response Action Outcome (RAO) Statement (Haley & Aldrich, October 1997) in accordance with the MCP. The RAO documented that a condition of no significant risk to human health existed at the Site as long as the Site use remained restricted in accordance with the AUL.

Between 1997 and 2016, the AUL was amended six times to allow alternative uses at portions of the property that were originally not allowed under the AUL. These amendments included allowing the use of the interior spaces of all buildings for unrestricted use, the use of certain outdoor areas for child day care play areas, and allowing light recreational use of the land area surrounding the Upper and Lower Shoe Ponds. For each amendment, additional site assessment and/or risk characterization was performed to document that the modification or removal of certain AUL restrictions would maintain a condition of no significant risk as defined by the MCP.

As part of the 2006 and 2008 AUL amendment process, soil gas testing was performed around the buildings to determine if the threat of vapor intrusion existed as a result of the residual contaminants that remained in the subsurface. While volatile compounds were detected in the soil gas samples, the risk characterizations concluded that no substantial vapor intrusion was present in the buildings. This information is included in the Fourth and Fifth Amendments to the Activity and Use Limitation, which were recorded with the South Essex County District Registry of Deeds in August 2006 and September 2008, respectively. The Sixth Amendment (recorded with the South Essex County District Registry of Deeds in June 2016) dealt specifically with the Elliott Landing parcel, a subset of the former USM property with a separate address of 201 Elliott Street, Beverly, MA and allowed residential use of such parcel. The Sixth AUL Amendment relied on data previously collected in this area of the property during the investigation of the Fifth Amendment.

In summary, the following potential contaminants of concern have been historically identified at this Site:

- (1) Volatile organic compounds (VOCs)
- (2) Semivolatile organic compounds (SVOCs)
- (3) Metals
- (4) Polychlorinated biphenyls (PCBs)
- (5) Petroleum hydrocarbons

Based upon review of the Site history and consideration of the current use of the Site, the primary question to be addressed by this investigation for this QAPP Addendum is whether contamination is present in the surface water and/or sediments of the Upper Shoe Pond or Lower Shoe Pond that would result in a significant risk to ecological receptors. There is no historical documentation suggesting that contaminants were directly discharged into the ponds. Therefore, the presence of contaminants of concern in the pond surface water or sediment would most likely be the result of migration via surface water runoff either directly into the ponds or into catch basins which ultimately discharge into the ponds. These ponds receive surface drainage from the facility and also from upgradient off-site drainage basins. According to the 1991 Phase II report, drainage basins which discharge surface water through the site en route to the Bass River measure approximately 3.3 square miles in area. These basins include the North Beverly Brook Drainage Basin and the Bass River Brook Drainage Basin. The Upper Shoe Pond drains through a spillway into the Lower Shoe Pond, which drains over a dam and into the Bass River via a covered channel. The dam between the Upper and Lower Shoe Ponds separates the fresh inland waters from the tidally influenced portion of the Bass River. In addition to former site-related contaminants, contaminants could have entered the ponds via upgradient drainage. Also, due to tidal influences, the Lower Shoe Pond could have received contaminants from parcels to the south that are downgradient (including the former southern parcel of the USM site).

The ecological risk assessment will consider both surface water and sediment exposure pathways to biota, including primary producers, fish, benthic infauna, and higher trophic levels consisting of terrestrial and avian herbivores and omnivores. Direct exposure to CoCs in sediment is most pronounced in the benthic infaunal community, due to close physical contact with sediment and pore water. Direct exposure to CoCs in surface water is most pronounced in the fish community, due to continuous exposure to surface water through respiration.

As one line of evidence in the ecological risk assessment, CoC sediment and surface water concentrations will be compared to conservative sediment and surface water screening benchmarks.

An additional line of evidence in the ecological risk assessment will be food chain modeling, which will incorporate standard assumptions regarding ingestion (nature of food items and amount) for representative receptor species. Exposure to CoCs through direct ingestion of surface water is not considered a significant source of exposure and risk, and therefore may be eliminated from the food chain model for simplicity. The model will consider standard uptake and bioaccumulation rates for lead, cadmium and PCBs, which have the potential to bioaccumulate in site organisms, and thereby present risk in multiple trophic levels.

Form D: Project Description

This Site has been identified in the U.S. EPA's RCRA 2020 Corrective Action Universe list. By the year 2020, EPA and the authorized states plan to have largely completed the work of implementing final remedies at all facilities requiring Corrective Action. This Site is listed under the site number MAD 043415991 as USM Machinery Division. Massachusetts has not been given RCRA authorization for this Site, therefore EPA is acting as the agency in charge for the RCRA program. As part of the RCRA 2020 program, EPA is overseeing an audit of the prior remedial actions conducted at the property. Despite that the Site has undergone significant site assessment and remediation, as summarized in Form C, the Site is not listed as Remedy Construction in the RCRA 2020 database.

The Quality Assurance Project Plan (QAPP) and Written Proposal/Sampling and Analysis Plan (SAP) dated September 29, 2017 documents the proposed sampling and monitoring activities to be implemented during the investigation for all aspects other than the ecological assessment.

This QAPP Addendum describes the QA/QC procedures for the ecological assessment to be employed to ensure the integrity, validity, and usability of analytical results to be relied upon in support of this project.

This plan defines sampling strategies, methods, and locations, analytical methods, data handling and tracking procedures, and specific QC procedures and QA mechanisms that will be used for this work. The purpose of the QAPP Addendum is to establish procedures to ascertain the precision, accuracy and representativeness, and objectives for the data collected for the ecological portion of the EPA audit.

There are two surface water bodies located on the North Parcel – the Upper and Lower Shoe Ponds. The Upper Shoe Pond is approximately 14 acres in size. It is primarily fed by the Bass River, which feeds into the pond through a culvert under McKay Street. A covered channel under Balch Street also discharges into the Upper Shoe Pond and the pond also receives direct surface water runoff from the area immediately surrounding the pond. The Lower Shoe Pond is approximately 3 acres in size and is fed primarily by the Upper Shoe Pond and the North Beverly Brook Drainage Basin. The Upper Shoe Pond drains through a spillway into the Lower Shoe Pond. Drainage from the North Beverly Brook Drainage Basin flows through the site through a system of underground channels which merge into a single point just prior to discharge into the Lower Shoe Pond. Site catch basins are linked to this channel system and discharge into the Lower Shoe Pond. The Lower Shoe Pond drains over a dam and into the Bass River via a covered channel. The spillway between the Upper and Lower Shoe Ponds separates the fresh inland waters from the tidally-influenced lower stretch of the Bass River.

As part of the 1991 Phase II Report, a total of 14 pond bottom sediment samples and 14 surface water samples were collected from the Upper and Lower Shoe Ponds in 1987 and 1988. Sample analyses included VOCs, SVOCs, TPH, PCBs, pesticides, priority pollutant metals, and cyanide.

A summary of the data results as presented in the Phase II report are included as **Appendix A**. Sample locations are shown in **Figure 4**. For the purposes of the Phase II, the area of the ponds was identified as Sector 1.

For VOC analysis, acetone was detected in 3 of the 14 sediment samples (all in the Upper Pond) with concentrations ranging from 59 parts per billion (ppb) to 68 ppb. VOCs were detected in 3 of the 14 surface water samples with total VOC concentrations ranging from 6 ppb to 8 ppb. Detected compounds were benzene (in the Upper Pond) and trichloroethylene (in the Lower Pond).

Measurable quantities of SVOCs were detected in 6 of the 14 sediment samples with trace concentrations detected in an additional 7 sediment samples. Total SVOC concentrations ranged from 1,000 ppb to 16,000 ppb. Detected compounds included benzo(a)pyrene, fluoranthene, pyrene, and bis(2-ethylhexyl)phthalate. The only SVOC detected in surface water was bis(2-ethylhexyl)phthalate, which was detected in 7 of the 14 surface water samples at concentrations ranging from 52 ppb (in the Upper Pond) to 5,400 ppb (in the Lower Pond).

TPH was analyzed in 12 of the sediment samples and was detected in each of these 12 samples at concentrations ranging from 92 ppm to 7,000 ppm. TPH was analyzed in 10 of the surface water samples, but was not detected in any of these samples.

PCBs were detected in one of the 14 sediment samples; Aroclor 1254 was detected at a concentration of 3.5 ppm from a sample in the Lower Pond. PCBs were analyzed in 13 surface water samples, but were not detected in any of these samples. No pesticides were detected in either sediment or surface water samples. Cyanide was not detected in any of the 7 sediment samples and 7 surface water samples that were analyzed.

Metals were analyzed in 6 sediment samples and 6 surface water samples. Antimony was not detected in any of these samples. Arsenic was not detected in any of the surface water samples, but was detected in all 6 sediment samples at concentrations ranging from 5.42 ppm to 35.8 ppm. Barium was detected in all 6 sediment samples at concentrations ranging from 20 ppm to 70 ppm and was detected in all 6 surface water samples at concentrations ranging from 20 ppb to 80 ppb. Beryllium was not detected in any of the surface water samples, but was detected in all 6 sediment samples at concentrations ranging from 0.2 ppm to 1.1 ppm. Cadmium was not detected in any of the surface water samples, but was detected in all 6 sediment samples at concentrations ranging from 1.4 ppm to 12 ppm. Chromium was not detected in any of the surface water samples, but was detected in all 6 sediment samples at concentrations ranging from 2 ppm to 46 ppm. Copper was detected in all 6 sediment samples at concentrations ranging from 13 ppm to 340 ppm and was detected in 2 surface water samples at concentrations ranging from 30 ppb to 180 ppb. Lead was detected in all 6 sediment samples at concentrations ranging from 10 ppm to 300 ppm and was detected in 3 surface water samples at concentrations ranging from 8 ppb to 60 ppb. Mercury was detected in 2 sediment samples at concentrations ranging from 0.16 ppm to 0.37 ppm and was detected in one surface water sample at a concentration of 0.7 ppb. Nickel was detected in all 6 sediment samples at concentrations ranging from 10 ppm to 70 ppm and was detected in all 6 surface water samples at concentrations ranging from 2 ppb to 9 ppb. Selenium was not detected

in any of the surface water samples, but was detected in one sediment sample at a concentration of 0.987 ppm. Silver was not detected in any of the surface water samples, but was detected in 4 sediment samples at concentrations ranging from 0.48 ppm to 8 ppm. Thallium was not detected in any of the sediment or surface water samples. Zinc was detected in all 6 sediment samples at concentrations ranging from 50 ppm to 530 ppm and was detected in 4 surface water samples at concentrations ranging from 10 ppb to 290 ppb.

In January 2012, a Screening Level Ecological Risk Assessment (SLERA) was completed by GEOSPHERE Environmental Management for the Upper and Lower Shoe Ponds. The Phase II data from 1987-88 was not used quantitatively in this SLERA due to its age. As these data are more than 20 years old, and since the USM facility has not been in operation since 1987, the use of this data was not viewed as representing current conditions at the site ponds. Also, analytical analysis technology was not as advanced during the Phase II data collection such that certain analyte detection limits were elevated compared to current analytical detection limits.

Therefore, new surface water and sediment data were collected from the ponds in June 2011; these data were used in the SLERA for quantitative purposes. Data used in the SLERA are summarized below.

Surface water and sediment samples were collected by GEOSPHERE from both the Upper and Lower Shoe Ponds on June 16, 2011. Six locations in the ponds were selected, and at each location both a surface water sample and sediment sample were collected. Two locations were selected from the Upper Shoe Pond and four locations were selected from the Lower Shoe Pond at locations similar to designated Phase II sampling locations in 1987-88 where elevated compounds of concern were detected.

Surface water samples were analyzed for VOCs, SVOCs, total Priority Pollutant Metals, PCBs (Aroclors only), VPH/EPH, total cyanide, total suspended solids, and hardness. No analyzed compounds were detected in any of the surface water samples with the exception of cyanide at a concentration of 15 micrograms per liter (ug/L) in one sample in the Lower Shoe Pond. **Table 1** presents a summary of the surface water data which compares the 2011 surface water data (with analytical detection limits) to the SLERA surface water screening levels (this table has been revised to reflect more recent EPA Region 4 screening values from 2015). Although 20 of the approximately 155 individual chemical analytes had analytical detection limits that exceeded the screening levels; the screening levels for the majority of such analytes, are not achievable by available analytical analysis technology. Most of these 20 analytes represent either VOCs or SVOCs that have never been detected at this site in any media.

Sediment samples were analyzed for VOCs, SVOCs, priority pollutant metals, PCBs, VPH/EPH, Acid-volatile sulfide-simultaneously extractable metals (AVS-SEM), total cyanide, and total organic carbon (TOC). Constituents identified in sediments included VOCs (limited to acetone and methyl ethyl ketone), PAHs, metals, PCBs, cyanide, EPH, and bis(2-ethylhexyl)phthalate. A summary of the data results as presented in the SLERA report are included as **Appendix A**. Sample locations are shown in **Figure 4**.

Two VOCs (acetone and methyl ethyl ketone) were identified in sediment; however, they were not identified as site-related contaminants from the Phase II data and thus were not considered to be site-related. These compounds (especially acetone) are often laboratory-related contaminants.

The SLERA concluded that surface water did not require further evaluation, as no compounds except cyanide were detected, and cyanide is not considered to be a site-related contaminant. The SLERA also concluded that in sediment, the SVOC bis(2-ethylhexyl)phthalate, and PCBs cannot be ruled out using screening tools; however the SLERA concluded that VOCs, VPH/EPH, PAHs, cyanide, metals, and other SVOCs in sediment were either not detected or pose negligible risk and thus do not require further evaluation.

The SLERA drew conclusions as to which contaminants and media required further evaluation. EPA performed a review of the 2012 SLERA. In its comments, EPA stated that while the SLERA used current EPA guidance, it did not adequately assess the potential for ecological risk to wildlife receptors foraging at the two ponds, and therefore did not provide a complete picture of the ecological risk potential at the two ponds (i.e., bird and mammal receptors feeding in and around the ponds). Also, EPA believed that certain conclusions of lack or risk to specific receptors were not fully supported by the data.

EPA's review of the previous sampling and risk assessment efforts has led them to request additional sampling for all media. Previous conclusions as outlined in the SLERA were not used in consideration of additional assessment. The Data Quality Objectives (DQOs) for the proposed sampling of sediment and surface water media in the ponds is to determine whether contamination exists in the Shoe Ponds that represents a risk to ecological receptors. Ecological receptors include truly aquatic organisms (e.g. fish, amphibians, benthic invertebrates) as well as other receptors that may be exposed to contaminants in pond media, such as piscivorous birds and mammals.

The following activities are planned as part of the Site investigation.

Ecological Investigation

Sediment and surface water will be assessed in both the Upper and Lower Shoe Ponds. See **Figures 6 and 7** for locations of these sample locations. Sampling plan details are included in Form E. Toxicity testing will be included as well as chemistry testing.

Data Validation

Following receipt of laboratory analytical data and laboratory quality assurance information, the laboratory analytical results will be verified by the QA Officer. Validation may be performed on the data but will be limited to holding times and QC results, as summarized on forms from the laboratory. A memorandum summarizing the results of the validation will be included in the preliminary and final reports.

Risk Characterization

After the completion of sampling events and toxicity testing, a risk characterization will be

performed as needed using the laboratory analysis data. The risk assessment will be in accordance with the applicable provisions of the MCP (310 CMR 40.0900) and the MassDEP Guidance document: *Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan: Chapter 9 – Method 3 Environmental Risk Characterization. Interim Final Policy WSC/ORS-95-141* as well as EPA Risk Assessment guidance and currently accepted standards for assessments of this nature. The general approach and principles to be followed include:

- Reliance on current, site-specific data for affected media;
- Utilization of multiple lines of evidence;
- Utilization of modelled receptor organisms that are appropriate for the actual ecological resources present at the site, with species-specific model inputs;
- A weight of evidence approach that incorporates multiple lines of evidence, and provides transparency in the assignment of weight and uncertainty with each line of evidence.

Project Reports

Specific reports for the individual components of this investigation shall be prepared in accordance with the Administrative Order on Consent for this facility.

Form E: Sampling and Analysis Plan

This section discusses the plan for samples to be collected and analysis performed to complete a Baseline Ecological Risk Assessment (“BERA”) for the Upper and Lower Shoe Ponds at this site.

Background:

A SLERA that describes Upper Shoe Pond and Lower Shoe Pond at the Former United Shoe Manufacturing Site was prepared in 2012. The SLERA concluded that certain contaminants of concern (“CoCs”) were present in the sediment at concentrations that do not allow for the site to be screened out relative to ecological receptors using benchmark screening. EPA provided written comments to the SLERA on May 4, 2012 and additional clarification to those comments during a meeting on May 8, 2018. The Work Plan presented below is based upon the SLERA assessment findings, EPA’s written comments and clarification (as requested by Cummings Properties), and field reconnaissance conducted by EcoTec on June 8, 2018 (described below).

Field Reconnaissance:

On June 8, 2018, Paul J. McManus, LSP, PWS, and Scott M. Morrison, RPSS, PWS conducted walking and kayak field reconnaissance of the Shoe Ponds and environs. The reconnaissance was designed to provide information useful in developing the proposed BERA Work Plan and included the following tasks:

- General habitat assessment of both ponds, including visual inspection of the interior portions and perimeters of both ponds, salinity measurements, and wildlife observations;
- Depth probes to obtain a general understanding of pond bathymetry and feasibility of potential sediment sampling equipment;
- Secchi disk depths of both ponds;
- Cursory preliminary sediment probing and sampling with and Ekman Dredge mounted on a pole, to determine feasibility of potential sediment sampling equipment; and
- Inspections of the contributing watershed to identify possible upstream sampling locations.

Pond characterization zones as established during the reconnaissance are shown in **Figure 5**. The findings of the preliminary field reconnaissance are attached in **Appendix B**.

Proposed Work Plan:

Details of the plan are discussed below. Locations of surface water and sediment samples to be collected in the Upper and Lower Shoe Ponds are shown in **Figure 6** and **Figure 7**.

1. Field evaluation to address SLERA data gaps: EPA identified several data gaps in the SLERA. These will be addressed by a growing season evaluation of the site by qualified ecologists (min 10 years’ experience). The evaluation will be completed by a combination of boat and shoreline (walking) inspections, and include assessment and documentation of the physical and biological characteristics of the two ponds, including:

- a. Bathymetry: depth measurement by weighted line, with plotting of bathymetry data points using GPS coordinates and reference to fixed features. Minimum number of points:
 - i. Lower Pond: 10;
 - ii. Upper pond: 25;Figures depicting depth measurements will be prepared;
- b. Secchi depth – concurrent with bathymetry measurements;
- c. Shoreline characteristics (substrate, vegetation, general topography, etc.);
- d. Substrate composition (to be preliminarily assessed during site reconnaissance, with more detailed evaluation during sediment sampling described below); and
- e. Identification of ecological receptors (communities and known or anticipated species).

The results of a June 8, 2018 Preliminary Field Reconnaissance and Habitat Assessment are included in **Appendix B**.

2. Revise ecological conceptual model (“ECM”): Based upon the field evaluation described above, the ECM will be revised and updated. A preliminary exposure pathways diagram is shown as **Figure 8**.
3. Surface water sampling:
 - a. Surface water contaminants of potential concern (“COPCs”). The SLERA (Table 4) concluded that surface water COPCs are limited to cyanide as only cyanide was detected in previous surface water samples in 2011. EPA commented that a surface water COPC selection table should be provided to justify and make transparent this conclusion. This has been included as **Table 1**. Although 27 of the approximately 155 individual chemical analytes had analytical detection limits that exceeded the screening levels; the screening levels for the majority of such analytes, are not achievable by available analytical analysis technology. Most of these 27 analytes represent either VOCs or SVOCs that have never been detected at this site in any media. Contamination at the site is the result of historic industrial activities, with associated historic management, control, and disposal practices. Current site activities are not contributors of contaminants to the ponds. In groundwater samples collected at the site in 2017-2018, there were no significant detections of any analytes (except for ethylbenzene, xylenes, 1,2-dichloroethene, and petroleum hydrocarbons in a single well; none of these analytes exceeded SLERA screening levels in surface water). Therefore, no substantial inputs of COCs to the surface water are occurring. Any trace levels of COCs that may be entering the ponds from road runoff or other similar sources are subject to substantial dilution. Historic sediment contamination that remains in the ponds is presumed to be located within the organic rich pond sediments (this will be verified during additional field assessment), which have a strong tendency to adsorb contaminants and therefore not be a significant source of contamination to surface water.

- b. Surface Water sampling: Surface water samples will be collected in accordance with the EcoTec surface water sampling SOP. Samples will not be collected during wet weather events. Surface water samples are proposed to be collected at the following locations:
 - i. Upper Pond: 6 samples: (primary inlet, north, center, south)
 - ii. Lower Pond: 4 samples: (near inlet, north, center, south)
 - iii. Upstream samples (assumes that access from the City of Beverly and private land owner can be obtained):

Norwood Lake (AKA Norwood Pond)

Kelleher Pond (AKA “Brimball Avenue Pond”)

Beaver Pond

- c. Surface Water Analytes: Surface water samples will be analyzed for the following COPC:
 - i. Cyanide (with field testing and treatment for oxidizing agents and sulfides in the field during sample collection, in accordance with the attached SOP);
 - ii. SVOCs (Method 8270);
 - iii. Dissolved priority pollutant metals (13);
 - iv. EPH (MassDEP Method);

In addition, analyses of the following general water quality parameters will be conducted on surface water samples:

Hardness

- 4. Sediment sampling: The preliminary sediment sampling in the SLERA will be expanded in scale and scope as follows:
 - a. Methods: Sampling will be conducted in accordance with EcoTec’s sediment sampling SOP. Based upon June 8, 2018 preliminary site reconnaissance, the majority of sediment samples will be collected with a closed-top sampler (petite ponar or Eckman), with shovel/scoop sampling in any exposed (i.e. above water level at time of sampling) near-shore areas (e.g. Lower Shoe Pond at low tide). Sediment exposed above standing water long-term (sediment delta in the Lower Shoe Pond) will not be sampled. Samples will consist of the top 15 cm (6 inches) of sediment;
 - b. Sample number: The following sediment samples are proposed to be collected:
 - i. Upper Pond: 12 samples;
 - ii. Lower Pond: 6 samples; and

iii. Upstream samples:

Norwood Lake (AKA Norwood Pond)

Kelleher Pond (AKA “Brimball Avenue Pond”)

Beaver Pond

- c. Sediment Analytes: Sediment samples will be analyzed for the following parameters:
- i. VOCs (Method 8260);
 - ii. SVOCs (Method 8270);
 - iii. Priority pollutant metals (13);
 - iv. PCBs (Aroclors with 10% subset for Homologs)
 - v. EPH (MassDEP Method);
 - vi. Total cyanide;
 - vii. Acid-volatile sulfide/ simultaneously extracted metals (“AVS-SEM”); and
 - viii. Total organic carbon (TOC).
5. Toxicity Testing: Based on the results of sediment chemistry results, additional sediment will be collected at selected locations for toxicity testing. Chemical analyses results will be utilized to determine which locations will be evaluated in this manner, with a goal of using a concentration gradient to develop a dose-response relationship (COPEC concentration vs toxic effect). For each selected location, 2 gallons of sediment will be collected in clean plastic pails, transported to EnviroSystems Inc. of Hampton, NH (“ESI”), and stored at ESI under appropriate refrigerated conditions to allow for toxicity testing. Approximately ten (10) sediment samples will be selected for toxicity testing, including at least one sample from each of the proposed upstream reference locations. The proposed toxicity testing will be conducted by ESI and consist of:

42-day *Hyaella azteca* chronic exposure whole sediment assay. Protocol based on Method 100.4 in Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates. EPA/R-99/064. March 2000. Assays to be conducted in a static renewal mode with daily renewal of overlying water. Replicates per treatment = 12. Monitoring of overlying water hardness, ammonia and alkalinity at the start of assay and on days 7, 14, 21 and 28 plus days 35 and 42. Endpoints evaluated are:

- a. survival at days 28, 35 and 42;
- b. growth (measured as dry weight and dry biomass) at days 28 and 42; and
- c. reproduction (measured as the numbers of juveniles produced per surviving amphipod by days 35 and 42, and juveniles produced per surviving female amphipod by day 42).

and

Chironomus dilutes (midge larvae) whole sediment assay emergence and chronic exposure sediment assay. Protocol based on Method 100.5 in Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates. EPA/R-99/064. March 2000. Daily renewal of overlying water. Monitoring of overlying water hardness, ammonia and alkalinity on days 0, 10 and 20. Endpoints evaluated are:

- a. Day 20 and end of assay survival;
- b. Day 20 growth, measured as both ash free dry weight and ash free dry biomass; and
- c. Percent emergence and mean time to emergence.

SOPs for the toxicity testing by ESI are appended.

6. Food chain modelling: Sediment and surface COPC concentrations determined in the sampling described above will be used to estimate effects of site COPCs on wildlife. Representative wildlife species chosen for this assessment are: muskrat, heron, and duck. Uptake factors (e.g. sediment to plant tissue) from the literature will be utilized and standardized ingestion factors (per USEPA Wildlife Exposure Factors Handbook) will be employed in the exposure calculations. Modelling will be based on biology (i.e., the actual diet of modelled receptor organisms).

The general model to be utilized for estimating doses of COPCs to wildlife is:

$$\text{ExposureDose}_{(\text{oral})} = [(\text{Conc}_{\text{food}} * \text{IR}_{\text{food}}) + (\text{RAF} * \text{Conc}_{\text{soil / sediment}} * \text{IR}_{\text{soil / sediment}}) + (\text{Conc}_{\text{sw}} * \text{IR}_{\text{water}})] * A / \text{fa}$$

where:

Exposure Dose_(oral) = receptor's daily dose of a COC (mg/kg-day);

Conc_{food} = Exposure point concentration of the COC (mg/kg wet) in the food (estimated);

IR_{food} = Daily food ingestion rate normalized to body weight (kg/kg-day) expressed in terms of wet weight/wet weight;

RAF = Relative availability factor for COPs in soil/sediment via incidental ingestion of wetland soil; in this case 100% availability of COCs in soil is assumed (RAF = 1);

Conc_{soil/sediment} = Exposure point concentration of the COC (mg/kg dry weight) in the

relevant exposure zone;

$IR_{\text{soil/sediment}}$ = Daily incidental ingestion rate of soil/sediment normalized to body weight (kg/kg/day) expressed in terms of dry weight/dry weight;

$Conc_{\text{water}}$ = Exposure point concentration of the COC (mg/liter) in water;

IR_{water} = Daily incidental ingestion rate of water normalized to body weight (l/kg/day) expressed in terms of wet weight/dry weight;

A/fa = Area of the Site (or region of interest within the Site)/total foraging area of the receptor. Where this ratio is greater than 1, it defaults to 1.

As a significant component of risk is unlikely from surface water consumption, this component of the model may be excluded.

7. Report: A BERA Report will be prepared, including methods, findings, and conclusions of the proposed investigations. The BERA report will include information to fill data gaps identified in USEPA comments. The report will include:
- i. Details of the COC and COPEC selection process.
 - ii. Benchmark comparisons against observed site maximum concentrations.
 - iii. Calculation of hazard quotients (HQs); including “no effect” benchmarks, “low effect” benchmarks, and how the site HQ compares within that “no effect” range, etc.
 - iv. Comparison against background concentrations, including how the incremental risk (IR) is going to be calculated (i.e., the separation of site related and non-site related risk) and the percentage of site risk/total risk to be considered "actionable."
 - v. How the various lines of evidence (i.e., chemical analysis, toxicity testing, AVS/SEM and food chain modeling), will be weighed against each other to summarize risk. The weight of each line of evidence will be assigned based upon a number of factors, including some that are not known at this time. For example, a very small exceedance of a standard would receive a lower weight than a very large exceedance of the same standard. EPA has expressed their opinion that a stronger weight of evidence should be placed on toxicity resting over AVS/SEM if AVS/SEM samples are collected in warm weather. Similarly, QC issues that may or may not arise will affect the weight assigned to a particular line of evidence.
 - vi. How any statistical representation of results will be considered as reflecting actionable risk. A weight of evidence approach, rather than reliance upon any

statistical cutoff, will be utilized to determine if risk requiring action exists. Standard statistical confidence assessment will be included in the toxicity testing, and the results of that assessment will be incorporated into the weight assigned to such line of evidence.

A weight of evidence evaluation of risk to ecological receptors will be prepared, including qualitative habitat impact assessment, benchmark comparisons, toxicity testing, and food chain modeling. The report will also include an uncertainty section which will include a discussion on analytical reporting limits and frequencies of detection. The discussion will include how uncertainty is added when reporting limits exceed benchmark values.

Health and safety and timing provisions: All personnel working on site will have appropriate current OSHA Hazwoper training. Personal protective equipment will be provided and will include rubber boots, gloves, and personal flotation devices (“PFDs”) for all work on water. PFDs will be worn at all times in boats.

Because much of the proposed work occurs in a small boat, safety considerations limit the conditions and time of year when the work can be safely conducted. Work in boats cannot be conducted during significant rain or wind events, or when temperatures are below approximately 40°F. Based upon typical weather patterns, a start date of after April 1 would be anticipated.

The laboratory selected to perform the chemical analysis is Alpha Analytical Inc. of Westborough, MA. Sediment toxicity testing is to be performed by EnviroSystems, Inc. of Hampton, NH. The two laboratory’s standard operating procedures (SOPs) for these analyses are included in **Appendix D**. The Alpha Analytical Inc. and EnviroSystems, Inc. laboratory Quality Assurance Manuals are included as **Appendix E**.

Form F-1: Method and SOP Reference Table

Analytical Method Reference:	Project Analytical SOPs*:
Acid Digestion of Aqueous Samples for Metals	ID No. 2151
Acid Digestion of Solid Samples for Metals	ID No. 2148
Acid Volatile Sulfides and Simultaneously Extracted Metals (AVS-SEM) in Sediments	ID No. 2140
Mercury Determination in Aqueous Samples	ID No. 2138
Mercury Determination in Solid Samples	ID No. 2139
Mercury Determination in Water Samples	ID No. 18715
Inductively Coupled Plasma – Atomic Emission Spectrometry	ID No. 18714
Total Organic Carbon and Soot in Soil, Sediment	ID No. 17452
Total and Amenable Cyanide	ID No. 2210
Total Solids in Solid and Semisolid Samples	ID No. 2229
Total Suspended Solids	ID No. 2220
Extractable Petroleum Hydrocarbons (MA-EPH)	ID No. 2119
Volatile Petroleum Hydrocarbons (MA VPH)	ID No. 2120
Volatile Organic Compounds EPA 8260	ID No. 2108
Semivolatile Organics by GC/MS EPA 8270	ID No. 2111
Soxhlet Extraction EPA 3540C	ID No. 1954
Separatory Funnel Extraction of Liquid Samples EPA 3510C	ID No. 1948
Polynuclear Aromatic Hydrocarbons (PAHs) by SIM EPA 8270 (M)	ID No. 2109
Microwave Extraction EPA 3546	ID No. 1959
Sulfuric Acid Cleanup	ID No. 2169
PCBs by Capillary Column GC	ID No. 2129
Determination of PCB Homologs and 136/209 Individual Congeners by GC/MS-SIM	ID No. 2162
Extraction of Water Samples by Separatory Funnel	ID No. 2165
Miscroscale Solvent Extraction	ID No. 2172
Silica Gel Cleanup Procedure	ID No. 2170
Soxhlet Extraction	ID No. 2173
Sediment Toxicity Method Reference:	Project SOPs*:
Chronic Toxicity of Sediments to Midge Larvae, <i>Chironomus dilutus</i> , Based on Emergence	QA-1470
Assessment Toxicity (42-Day) of Sediments to the Amphipod, <i>Hyalella azteca</i> based on Survival and Growth	QA-1466

*see **Appendix D** for copies of referenced SOPs.

Form F-1: Method and SOP Reference Table (Continued)

Project Sampling SOPs:**
EcoTec Protocol #1, SEDIMENT COLLECTION FOR ENVIRONMENTAL SAMPLES
EcoTec Protocol #2, SURFACE WATER COLLECTION FOR ENVIRONMENTAL SAMPLES
EcoTec Protocol #3, FIELD CHLORINE TESTING FOR ENVIRONMENTAL SAMPLES
FSL Protocol #11, ENVIRONMENTAL SAMPLE HANDLING
FSL Protocol #12, EQUIPMENT DECONTAMINATION
FSL Protocol #13, FIELD NOTES AND DOCUMENTATION

** See **Appendix C** for copies of referenced SOPs.

Form F-2: Sampling and Analytical Methods Requirements

Parameter	Matrix	Analytical Method	Analytical SOP	Containers per Sample (number, size and type)	Preservation Requirements (temperature, chemical)	Maximum Holding Time (to extraction)	Lab Holding Time (after extraction)
AVS-SEM	Sediment	EPA 821-R-91-100 and AVSSEM SOP v2.0	ID No. 2140	1 x 8 oz glass jar	Refrigerate to between 2° and 6° C	14 days	N/A
Metals	Sediment	SW846 6010C	ID No. 18714	1 x 8 oz plastic jar	None	6 months	N/A
Metals	Surface Water	SW846 6010C	ID No. 18714	1 x 8 oz plastic jar	HNO ₃	6 months	N/A
Mercury	Sediment	SW846 7471B	ID No. 2139	1 x 8 oz glass jar	Refrigerate to between 2° and 6° C	28 days	N/A
Mercury	Surface Water	EPA 245.1	ID No. 18715	1 x 8 oz glass or plastic jar	HNO ₃	28 days	N/A
Cyanide	Sediment	SW846 9010C/9012B	ID No. 2110	1 x 8 oz glass or plastic jar	Refrigerate to between 2° and 6° C	14 days	N/A
Cyanide	Surface Water	SW846 9010C/9012B	ID No. 2110	1 x 8 oz glass or plastic jar	NaOH; refrigerate to between 2° and 6° C	14 days	N/A
TOC	Sediment	SW 846 9060A	ID No. 17452	1 x 8 oz glass jar	Refrigerate to between 2° and 6° C	28 days	N/A
TSS	Sediment	SM 2540D	ID No. 2220	1 x 8 oz glass or plastic jar	Refrigerate to between 2° and 6° C	7 days	N/A
Total Solids	Sediment	SM 2540C	ID No. 2229	1 x 8 oz glass jar	Refrigerate to 4° C	N/A	N/A
VOCs	Sediment	EPA 8260C	ID No. 2108	High Level: 1 x 40 ml VOA vial Low Level: 2 x 40 ml VOA vial	High Level: Methanol Low Level: Sodium bisulfate or water; HCl; refrigerate to between 2° and 6° C	14 days; 7 days for unpreserved samples that require aromatic analysis	N/A
VOCs	Surface Water	EPA 8260C	ID No. 2108	2 x 40 ml VOA vial	HCl; refrigerate to between 1° and 4° C	14 days	N/A

Parameter	Matrix	Analytical Method	Analytical SOP	Containers per Sample (number, size and type)	Preservation Requirements (temperature, chemical)	Maximum Holding Time (to extraction)	Lab Holding Time (after extraction)
SVOCs	Sediment	EPA 8270	ID No. 2111/2109	1 x 250 ml wide-mouth amber glass jar	Refrigerate to between 2° and 6° C	14 days	40 days
SVOCs	Surface Water	EPA 8270	ID No. 2111/2109	2 x 1.0 liter amber glass jar	Refrigerate to between 2° and 6° C	7 days	40 days
Volatile Petroleum Hydrocarbons	Surface Water	Mass VPH	ID No. 2120	3 x 40 ml VOA vial	HCl; refrigerate to 4° C	14 days	N/A
Extractable Petroleum Hydrocarbons	Sediment	Mass EPH	ID No. 2119	1 x 250 ml wide-mouth amber glass jar	Refrigerate to between 2° and 6° C	14 days	40 days
Extractable Petroleum Hydrocarbons	Surface Water	Mass EPH	ID No. 2119	2 x 1.0 liter amber glass jar	HCl; refrigerate to between 2° and 6° C	14 days	40 days
PCBs	Surface Water	PCB Homologs	ID No. 2162	2 x 1.0 liter amber glass jar	Refrigerate to 4° C	7 days	40 days
PCBs	Sediment	PCB Homologs	ID No. 2162	2 x 8 oz glass jar	Refrigerate to 4° C	14 days	40 days
PCBs	Sediment	Aroclors	ID No. 2129	1 x 250 ml wide-mouth glass jar with Teflon-lined lid	Refrigerate to between 2° and 6° C	14 days	40 days
Sediment Toxicity	Sediment	N/A	QA-1470	1 x 1 gal plastic bucket	Refrigerate to between 2° and 6° C	8 weeks	N/A
Sediment Toxicity	Sediment	N/A	QA-1446	1 x 1 gal plastic bucket	Refrigerate to between 2° and 6° C	8 weeks	N/A

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Date: Date: March 13, 2020
Revision 2
Site Name: United Shoe Machinery Division North Parcel
Site Location: 181 Elliott Street, Beverly, MA

Form G: Preventive Maintenance – Field Equipment

Not Applicable.

Title: QAPP Addendum

Date: March 13, 2020

Revision 2

Site Name: United Shoe Machinery Division North Parcel

Site Location: 181 Elliott Street, Beverly, MA

Form H: Calibration and Corrective Action – Field Equipment

Not Applicable.

Form I: Preventive Maintenance – Laboratory Equipment

The following acronyms are utilized in Form I and J:

ICAP: Inductively Coupled Argon Plasma Emission Spectrometer

GC: Gas Chromatograph

MS: Mass Spectrometer

See Alpha Analytical Quality Systems Manual (AQSM) for a listing of Equipment Brands and Model Numbers.

Instrument	Activity	Frequency	SOP Reference
ICAP	Inspect nebulizer pump tubing; replace if necessary	Daily	SOP/ID No. 18714
	Remove and clean the torch, “shot glass”, nebulizer, and spray chamber	Monthly	
	Check cooling system, flush/refill chiller, clean instrument, clean/replace air filters	Semi-annually	
Mercury Analyzer	Inspect pump windings and replace as needed	Daily	SOP/ID No. 2139
	Replace dryer tube	Annually	
	Clean gas-liquid separator	Periodically	
CHNS/O Analyzer	Replace combustion column	As needed	SOP/ID No. 17452
GC injector septa and injector lines	Replace	When performance criteria cannot be met	SOP/ID No. 2119/2120
GC purge and trap tubes	Replace	Semi-annually	SOP/ID No. 2108
GC Sparge needles	Rinse	Periodic	SOP/ID No. 2108

Instrument	Activity	Frequency	SOP Reference
Cyanide Midi Distillation Unit	Clean injection points Clean unions and tees associated with manifold Replace o-rings in manifold and injection valve		SOP/ID No. 2210
GC PID Lamp	Replace	90-180 days	SOP/ID No. 2120
GC	Clip several inches off injector end of capillary column	As needed	SOP/ID No. 2119/2120
GC	Injection port preparation; cleaning of detectors	As needed	AQSM
GC	Initial multi-point calibration	As needed	AQSM
GC	Continuing calibration verification (CCV) against initial calibration	Beginning and end of batch and 10 to 20 samples as per method	AQSM
MS	Change of mechanical pump oil by service technician (external)	Bi-annually	AQSM
MS	Cleaning of source	As needed	AQSM
MS	BFB, DFTPP, or ICP-MS tune analysis followed by ICAC or CCV	12 hr or daily	AQSM

Form J: Calibration and Corrective Action – Laboratory Equipment

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
GC/MS	Daily Performance Check	Every 24 hours or less	Manual PFTBA tuning	Adjust lens or ion focus; retune	SOP/ID No. 2162
GC/MS	Initial Calibration (5 standard concentrations)	Prior to sample analysis	<20% RSD for all analytes; 10% of analytes may be between 20% and 30% RSD	Recalibrate	SOP/ID No. 2162
GC/MS	Initial Calibration Verification (separate source standard)	Every time an initial calibration is performed	± 30 % difference for all analytes	Recalibrate	SOP/ID No. 2162
GC/MS	Continuing Calibration Check	Every 12-18 hours	Compare to initial calibration, % difference must be <20%, but 10% of analytes may be between 20% and 30% difference	Repeat analysis, recalibrate	SOP/ID No. 2162
GC/MS	Initial Calibration (5 standard concentrations)	Every 24 hours or less	<20% RSD for any analyte	Recalibrate prior to processing any samples	SOP/ID No. 2111
GC/MS	Initial Calibration Verification	Prior to sample analysis	<30 % difference for all analytes	Recalibrate prior to processing any samples	SOP/ID No. 2111
GC/MS	Continuing Calibration Check	Every 12 hours	<20 % difference for all analytes	Perform maintenance, recalibrate	SOP/ID No. 2111
GC	Initial Calibration (Analysis of continuing calibration standard)	Every time an initial calibration is performed	The recovery must be between 70% and 130%. The recovery of difficult compounds must be between 40% and 160%	Recalibrate	SOP/ID No. 2108

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
GC	Continuing Calibration Check	Every 12 hours	Compare to initial calibration, % difference must be <20% ; <30% for SIM compounds	Repeat analysis, recalibrate	SOP/ID No. 2108
GC	Initial Calibration (Analysis of continuing calibration standard)	Every time an initial calibration is performed	An ICV needs to be analyzed with a $\pm 20\%$ recovery	Recalibrate	SOP/ID No. 2120
GC	Continuing Calibration Check	Every 20 samples	The %D has to be within 25% when compared to the mean response factor from the initial calibration.	Repeat analysis, recalibrate	SOP/ID No. 2120
GC	Initial Calibration (Analysis of continuing calibration standard)	Every time an initial calibration is performed	The initial calibration is verified using a standard source different than that used for the initial calibration. This standard is analyzed immediately after each initial calibration. Percent recoveries must be between 80-120% for each target analyte.	Recalibrate	SOP/ID No. 2119
GC	Continuing Calibration Check	Every 20 samples or 24 hours	The %D for all aliphatic and aromatic analytes must be less than or equal to 25% except for n-nonane, which must be <30	Repeat analysis, recalibrate	SOP/ID No. 2119

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
ICAP	Initial Calibration	Daily	Per manufacture specifications	Recalibrate	SOP/ID No. 18714
ICAP	Initial Calibration Verification (separate source standard)	Every time an initial calibration is performed	Within 10% of expected value	Repeat analysis, recalibrate	SOP/ID No. 18714
ICAP	Continuing Calibration Check	Every 10 th sample and at the end of a sample run	Within 10% of expected value	Repeat analysis, recalibrate	SOP/ID No. 18714
Mercury Analyzer	Initial Calibration (5 standard concentrations)	Daily	Correlation coefficient must be ≥ 0.995	Repeat analysis, recalibrate	SOP/ID No. 2139
Mercury Analyzer	Initial Calibration Verification (separate source standard)	Every time an initial calibration is performed	Recovery between 90%-110% of expected value	Repeat analysis, recalibrate	SOP/ID No. 2139
Mercury Analyzer	Continuing Calibration Check	Every 10 th sample and at the end of a sample run	Recovery between 90%-110% of expected value	Repeat analysis, recalibrate	SOP/ID No. 2139
Cyanide Midi Distillation Unit	Initial Calibration (7 standard concentrations)	Daily	Correlation coefficient must be ≥ 0.995	Recalibrate	SOP/ID No. 2210
Cyanide Midi Distillation Unit	Initial Calibration Verification (separate source standard)	Every time an initial calibration is performed	<10% difference from the 0.1 ppm standard	Recalibrate	SOP/ID No. 2210
Cyanide Midi Distillation Unit	Continuing Calibration Check	Every 10 th sample and at the end of a sample run	<10% difference from the 0.1 ppm standard	Recalibrate	SOP/ID No. 2210
CHNS/O Analyzer	Initial Calibration	Daily	The K-Factors must reproduce from the mean value within $\pm 15\%$ of known K factor for each instrument for carbon.	Repeat analysis, recalibrate	SOP/ID No. 17452

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
CHNS/O Analyzer	Initial Calibration Verification (separate source standard)	Beginning of sample run	Within 20% of expected value	Repeat analysis, recalibrate	SOP/ID No. 17452
CHNS/O Analyzer	Continuing Calibration Check	Every 10 th sample and at the end of a sample run	Within 20% of expected value	Repeat analysis, recalibrate	SOP/ID No. 17452
GC/MS	Hardware tuning	Before performing the initial and continuing calibrations	Results must meet the peak ratio specifications of the analytical methods: Volatiles analysis = Bromofluorobenzene; semi-volatiles analysis = decafluoro- triphenylphosphine	Retune	AQSM
GC/MS	Initial Calibration (Analysis of continuing calibration standard)	Start of each day	Dependent on the requirements of the specific method. The % difference must be less than the acceptance criteria stated in the method	Instrument maintenance or new initial calibration	AQSM
GC/MS	Continuing Calibration	Every 12 hours	Must have measured % differences for the analytes within method specified ranges	Instrument maintenance or new initial calibration	AQSM
GC	Initial Calibration (Analysis of continuing calibration standard)	Start of each day	Dependent on the requirements of the specific method. The % difference must be less than the acceptance criteria stated in the method	Instrument maintenance or new initial calibration	AQSM

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Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
GC	Continuing Calibration	Every 12 hours or 20 samples	Must have measured % differences for the analytes within method specified ranges	Instrument maintenance or new initial calibration	AQSM

Form K: Sample Handling and Custody Requirements

The purpose of chain-of-custody procedures is to document the identity of the sample and its handling from its first existence as a sample until analysis and data reduction are completed. Custody records trace a sample from its collection through all transfers of custody until it is transferred to the analytical laboratory. Internal laboratory records then document the custody of the sample through its final disposition.

All materials such as field and laboratory notebooks and logbooks, field and laboratory data records, correspondence, reports, chain-of-custody records and instrument printouts will be clearly labeled with the project number and become a permanent part of the project file.

This protocol details the procedures for sample container handling, following collection in the field.

1. Upon sample collection, each sample container is affixed with an identification label that contains the following information, at a minimum:

Surface Water/Sediment Samples

- client/project name
- field sample identification number
- start and end date and time of sample collection
- analysis required
- preservative

Sample containers will be labeled, using an indelible ink marker, with sample identification, date, and time at the time a sample is actually collected to prevent accidental mix-up of samples that may occur when containers are pre-labeled prior to a sampling event. Other information (project name and number, analysis type, preservation type, and sampler's name) may be completed on the sample label prior to sample collection.

2. A Chain of Custody form is to be filled out as the samples are collected. Samples are entered onto the form in the order in which they are collected. All data recorded on the sample container label is copied onto the Chain of Custody form. Obvious contamination observed in the sampled material is noted on the Chain of Custody form. A copy of the Chain of Custody form should be maintained for project files.

3. Depending on site specifics, samples may be picked up in the field by the laboratory, delivered directly to the laboratory by FSL, or returned to the FSL office. If samples are returned to the FSL office, samples will be placed inside a refrigerator to maintain the required sample temperature. FSL will contact the laboratory for a courier pickup of the samples. All samples will be received

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by the laboratory within 48 hours (72 hours if a weekend or holiday interferes) of their collection, unless the analytical method requires a more rapid turn-round time, thus necessitating more rapid delivery.

Form L: Analytical Precision and Accuracy

Analyte	Analytical Method	Soil Reporting Limit for Low-Level Aqueous Preserved Samples¹ (µg/kg)	Soil Reporting Limit for High-Level Methanol Preserved Samples¹ (µg/kg)	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
VOCs (list)	EPA 8260C and 5035A/8260C					
1,1,1-trichloroethane	EPA 8260C and 5035A/8260C	1	50	30	0.5	11
1,1,1,2-tetrachloroethane	EPA 8260C and 5035A/8260C	1	50	No Value	0.5	85
1,1,2,2-tetrachloroethane	EPA 8260C and 5035A/8260C	1	50	850	0.5	200
1,1,2-trichloroethane	EPA 8260C and 5035A/8260C	1.5	75	518	0.75	500
1,1-dichloroethane	EPA 8260C and 5035A/8260C	1.5	75	0.575	0.75	47
1,1-dichloroethene	EPA 8260C and 5035A/8260C	1	50	19.4	0.5	25
1,1-dichloropropene	EPA 8260C and 5035A/8260C	2.5	250	No Value	2.5	No Value
1,2,3-trichlorobenzene	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	5
1,2,3-trichloropropane	EPA 8260C and 5035A/8260C	10	500	No Value	5.0	No Value
1,2,4-trichlorobenzene	EPA 8260C and 5035A/8260C	5	250	5062	2.5	30
1,2,4-trimethylbenzene	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	13
1,2-dibromo-3-chloropropane	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
1,2-dibromoethane	EPA 8260C and 5035A/8260C	5	250	No Value	2.0	No Value

Analyte	Analytical Method	Soil Reporting Limit for Low-Level Aqueous Preserved Samples ¹ (µg/kg)	Soil Reporting Limit for High-Level Methanol Preserved Samples ¹ (µg/kg)	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
1,2-dichlorobenzene	EPA 8260C and 5035A/8260C	5	250	294	2.5	14
1,2-dichloroethane	EPA 8260C and 5035A/8260C	1	50	250	0.5	910
1,2-dichloropropane	EPA 8260C and 5035A/8260C	3.5	175	333	1.75	360
1,3,5-trichlorobenzene	EPA 8260C and 5035A/8260C	5	250	No Value	2.0	No Value
1,3,5-trimethylbenzene	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	26
1,3-dichlorobenzene	EPA 8260C and 5035A/8260C	5	250	1315	2.5	14
1,3-dichloropropane	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
1,4-dichlorobenzene	EPA 8260C and 5035A/8260C	5	250	318	2.5	9.4
1,4-dichlorobutane	EPA 8260C and 5035A/8260C	10	500	No Value	5.0	No Value
2,2-dichloropropane	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
2-butanone	EPA 8260C and 5035A/8260C	10	500	42.4	5.0	2200
2-chloroethylvinyl ether	EPA 8260C and 5035A/8260C	20	1000	No Value	10.0	No Value
2-hexanone	EPA 8260C and 5035A/8260C	10	500	22	5.0	99
Acetone	EPA 8260C and 5035A/8260C	10	250	8.7	5.0	1500
Acrylonitrile	EPA 8260C and 5035A/8260C	5	200	1.2	5.0	No Value

Analyte	Analytical Method	Soil Reporting Limit for Low-Level Aqueous Preserved Samples ¹ (µg/kg)	Soil Reporting Limit for High-Level Methanol Preserved Samples ¹ (µg/kg)	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
Benzene	EPA 8260C and 5035A/8260C	1	50	142	0.5	114
Bromobenzene	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
Bromochloromethane	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
Bromodichloromethane	EPA 8260C and 5035A/8260C	1	50	No Value	0.5	No Value
Bromoform	EPA 8260C and 5035A/8260C	4	200	492	2.0	230
Bromomethane	EPA 8260C and 5035A/8260C	2	100	1.37	1.0	No Value
Carbon disulfide	EPA 8260C and 5035A/8260C	10	500	0.85	5.0	0.92
Carbon tetrachloride	EPA 8260C and 5035A/8260C	1	50	47	0.5	9.8
Chlorobenzene	EPA 8260C and 5035A/8260C	1	50	291	0.5	25
Chloroethane	EPA 8260C and 5035A/8260C	2	100	No Value	1.0	No Value
Chloroform	EPA 8260C and 5035A/8260C	1.5	75	22	0.75	20
Chloromethane	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
Cis-1,2-dichloroethene	EPA 8260C and 5035A/8260C	1	50	400	0.5	590
Cis-1,3-dichloropropene	EPA 8260C and 5035A/8260C	1	50	0.051	0.5	0.055
Cyclohexanone	EPA 8260C and 5035A/8260C	20	1000	No Value	10	No Value

Analyte	Analytical Method	Soil Reporting Limit for Low-Level Aqueous Preserved Samples ¹ (µg/kg)	Soil Reporting Limit for High-Level Methanol Preserved Samples ¹ (µg/kg)	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
Dibromochloromethane	EPA 8260C and 5035A/8260C	1	50	No Value	0.5	320
Dibromomethane	EPA 8260C and 5035A/8260C	10	500	No Value	5.0	No Value
Dichlorodifluoromethane	EPA 8260C and 5035A/8260C	10	500	No Value	5.0	No Value
Ethylbenzene	EPA 8260C and 5035A/8260C	1	50	89	0.5	7.3
Ethyl ether	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
Ethyl methacrylate	EPA 8260C and 5035A/8260C	10	500	No Value	5.0	No Value
Hexachlorobutadiene	EPA 8260C and 5035A/8260C	5	250	26.5	0.5	0.053
Isopropyl benzene	EPA 8260C and 5035A/8260C	1	50	No Value	0.5	4.8
Methylene chloride	EPA 8260C and 5035A/8260C	10	500	159	3.0	940
MIBK	EPA 8260C and 5035A/8260C	10	500	25.1	5.0	170
MTBE	EPA 8260C and 5035A/8260C	2	100	No Value	1.0	730
M+p-xylene	EPA 8260C and 5035A/8260C	2	100	160	1.0	13
Naphthalene	EPA 8260C and 5035A/8260C	5	250	176	2.5	12
n-butyl benzene	EPA 8260C and 5035A/8260C	1	50	No Value	0.5	No Value
n-propylbenzene	EPA 8260C and 5035A/8260C	1	50	No Value	0.5	No Value

Analyte	Analytical Method	Soil Reporting Limit for Low-Level Aqueous Preserved Samples ¹ (µg/kg)	Soil Reporting Limit for High-Level Methanol Preserved Samples ¹ (µg/kg)	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
o-chlorotoluene	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
o-xylene	EPA 8260C and 5035A/8260C	2	100	160	1.0	13
p-chlorotoluene	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
p-isopropyltoluene	EPA 8260C and 5035A/8260C	1	50	No Value	0.5	16
Sec-butyl benzene	EPA 8260C and 5035A/8260C	1	50	No Value	0.5	No Value
Styrene	EPA 8260C and 5035A/8260C	2	100	254	1.0	32
Tert-butyl benzene	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
Tetrachloroethene	EPA 8260C and 5035A/8260C	1	50	990	0.5	45
Tetrahydrofuran	EPA 8260C and 5035A/8260C	20	1000	No Value	10.0	11,000
Toluene	EPA 8260C and 5035A/8260C	1	75	50	0.75	9.8
Trans-1,2-dichloroethene	EPA 8260C and 5035A/8260C	1.5	75	400	0.75	558
Trans-1,3-dichloropropene	EPA 8260C and 5035A/8260C	1	50	0.051	0.5	0.055
Trans-1,4-dichloro-2-butene	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value
Trichloroethene	EPA 8260C and 5035A/8260C	1	50	112	0.5	47
Trichlorofluoromethane	EPA 8260C and 5035A/8260C	5	250	No Value	2.5	No Value

Analyte	Analytical Method	Soil Reporting Limit for Low-Level Aqueous Preserved Samples¹ (µg/kg)	Soil Reporting Limit for High-Level Methanol Preserved Samples¹ (µg/kg)	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
Vinyl acetate	EPA 8260C and 5035A/8260C	10	500	0.84	5.0	No Value
Vinyl chloride	EPA 8260C and 5035A/8260C	2	100	202	1.0	930

Analyte	Analytical Method	Soil and Solid Reporting Limit (mg/kg) ¹	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
VPH (list)	MA VPH				
Benzene	MA VPH	0.10	142	2.00	114
Toluene	MA VPH	0.10	50	2.00	9.8
Ethylbenzene	MA VPH	0.10	89	2.00	7.3
m/p-Xylenes	MA VPH	0.10	160	2.00	13
o-Xylene	MA VPH	0.10	160	2.00	13
Naphthalene	MA VPH	0.50	176	10.00	12
MTBE	MA VPH	0.05	No Value	3.00	730
C ₅ -C ₈ Aliphatic Hydrocarbons	MA VPH	2.50	1,591,000*	50.00	No Value
C ₉ -C ₁₂ Aliphatic Hydrocarbons	MA VPH	2.50	2,722,000*	50.00	No Value
C ₉ -C ₁₀ Aromatic Hydrocarbons	MA VPH	2.50	236,000*	50.00	No Value
EPH (list)	MA EPH				
Naphthalene	MA EPH	0.33	176	10	12
2-Methylnaphthalene	MA EPH	0.33	20.2	10	4.7
Acenaphthylene	MA EPH	0.33	5.87	10	13
Acenaphthene	MA EPH	0.33	6.71	10	15
Fluorene	MA EPH	0.33	77	10	3.9
Phenanthrene	MA EPH	0.33	200	10	2.3
Anthracene	MA EPH	0.33	57	10	0.02
Fluoranthene	MA EPH	0.33	420	10	0.8
Pyrene	MA EPH	0.33	195	10	0.3
Benzo(a)anthracene	MA EPH	0.33	108	10	0.025

Analyte	Analytical Method	Soil and Solid Reporting Limit (mg/kg) ¹	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
Chrysene	MA EPH	0.33	166	10	4.7
Benzo(b)fluoranthene	MA EPH	0.33	10,400	10	2.6
Benzo(k)fluoranthene	MA EPH	0.33	240	10	0.64
Benzo(a)pyrene	MA EPH	0.33	140	10	0.0014
Indeno(1,2,3-cd)pyrene	MA EPH	0.33	200	10	0.28
Dibenzo(a,h)anthracene	MA EPH	0.33	33	10	0.28
Benzo(g,h,i)perylene	MA EPH	0.33	170	10	0.44
C ₉ -C ₁₈ Aliphatic Hydrocarbons	MA EPH	6.67	3,167,000*	100	No Value
C ₁₉ -C ₃₆ Aliphatic Hydrocarbons	MA EPH	6.67	9,883,000*	100	No Value
C ₁₁ -C ₂₂ Aromatic Hydrocarbons	MA EPH	6.67	92,000*	100	No Value

*Values are from *Sediment Toxicity of Petroleum Hydrocarbon Fractions*, September 2007 by BATTELLE. EPA Region 4 guidance has freshwater sediment screening values for total petroleum hydrocarbons of 340,000 µg/kg dry weight (diesel) and 3,600,000 µg/kg dry weight (residual).

Analyte	Analytical Method	Soil and Solid Reporting Limit (µg/kg) ¹	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
SVOCs (list)	EPA 8270				
Acenaphthene	EPA 8270	133.34	6.71	2	15
Acenaphthylene	EPA 8270	133.34	5.87	2	13
Acetophenone	EPA 8270	333.34	No Value	5	No Value
Aniline	EPA 8270	133.34	0.31	2	4.1
Anthracene	EPA 8270	133.34	57	2	0.02
Atrazine	EPA 8270	666.67	No Value	10	No Value
Azobenzene	EPA 8270	500	No Value	2	No Value
Benzaldehyde	EPA 8270	333.34	No Value	5	No Value
Benidine	EPA 8270	1333.34	1.7	20	No Value
Benzo(a)anthracene	EPA 8270	133.34	108	2	0.025
Benzo(b)fluoranthene	EPA 8270	133.34	10,400	2	2.6
Benzo(k)fluoranthene	EPA 8270	133.34	240	2	0.64
Benzo(g,h,i)perylene	EPA 8270	133.34	170	2	0.44
Benzo(a)pyrene	EPA 8270	133.34	140	2	0.014
Benzoic acid	EPA 8270	3333.34	No Value	50	No Value
Benzyl alcohol	EPA 8270	133.34	1.04	2	No Value
Biphenyl	EPA 8270	366.67	No Value	2	No Value
Bis(2-chloroethyl)ether	EPA 8270	133.34	3520	2	19,000
Bis(2-chloroisopropyl)ether	EPA 8270	133.34	No Value	2	No Value
Bis(2-chloroethoxy)methane	EPA 8270	333.34	No Value	5	No Value
Bis(2-ethylhexyl)phthalate	EPA 8270	200	182	3	0.3

Analyte	Analytical Method	Soil and Solid Reporting Limit (µg/kg) ¹	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
4-Bromophenyl phenyl ether	EPA 8270	133.34	No Value	2	1.5
Butyl benzyl phthalate	EPA 8270	333.34	1970	5	19
Caprolactam	EPA 8270	666.67	No Value	10	No Value
Carbazole	EPA 8270	166.67	No Value	2	No Value
2-Chloroaniline	EPA 8270	NA	No Value	2	No Value
3-Chloroaniline	EPA 8270	NA	No Value	10	No Value
4-Chloroaniline	EPA 8270	333.34	146	5	19
p-Chloro-m-cresol (4-chloro-3-cresol)	EPA 8270	133.34	No Value	2	No Value
2-Chloronaphthalene	EPA 8270	133.34	417	2	0.396
2-Chlorophenol	EPA 8270	133.34	31.9	2	24
4-Chlorophenyl phenyl ether	EPA 8270	133.34	No Value	2	No Value
Chrysene	EPA 8270	133.34	166	2	4.7
m/p-Methylphenol	EPA 8270	333.34	No Value	5	No Value
o-Methylphenol	EPA 8270	333.34	No Value	5	13
Dibenzo(a,h)anthracene	EPA 8270	133.34	33	2	0.28
Dibenzofuran	EPA 8270	133.34	449	2	3.7
Di-n-butylphthalate	EPA 8270	333.34	1114	5	9.7
1,2-Dichlorobenzene	EPA 8270	133.34	294	2	14
1,3-Dichlorobenzene	EPA 8270	NA	1315	2	14
1,3-Dinitrobenzene	EPA 8270	133.34	8.61	2	No Value
1,4-Dichlorobenzene	EPA 8270	133.34	318	2	9.4
3,3-Dichlorobenzidine	EPA 8270	133.34	127	5	4.5

Analyte	Analytical Method	Soil and Solid Reporting Limit (µg/kg) ¹	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
2,4-Dichlorophenol	EPA 8270	333.34	81.7	5	11
2,6-Dichlorophenol	EPA 8270	666.67	No Value	10	No Value
Diethyl phthalate	EPA 8270	333.34	295	5	110
3,3-Dimethylbenzidine	EPA 8270	500	No Value	4	No Value
2,4-Dimethylphenol	EPA 8270	333.34	304	5	15
Dimethyl phthalate	EPA 8270	333.34	No Value	5	1,100
4,6-Dinitro-o-cresol	EPA 8270	666.67	No Value	10	No Value
2,4-Dinitrophenol	EPA 8270	1133.34	6.21	20	19
2,4-Dinitrotoluene	EPA 8270	333.34	14.4	5	44
2,6-Dinitrotoluene	EPA 8270	333.34	39.8	5	81
Di-n-octylphthalate	EPA 8270	333.34	40,600	5	No Value
Diphenamide	EPA 8270	NA	No Value	5	No Value
Ethyl Parathion	EPA 8270	166.67	No Value	NA	No Value
Fluoranthene	EPA 8270	133.34	420	2	0.8
Fluorene	EPA 8270	133.34	77	2	19
Hexachlorobenzene	EPA 8270	133.34	20	2	0.0003
Hexachlorobutadiene	EPA 8270	133.34	26.5	2	0.053
Hexachlorocyclopentadiene	EPA 8270	1333.34	901	20	No Value
Hexachloroethane	EPA 8270	133.34	584	2	8
Indeno(1,2,3-cd)pyrene	EPA 8270	133.34	200	2	0.28
Isophorone	EPA 8270	333.34	432	5	920
1-Methylnaphthalene	EPA 8270	166.67	130	2	No Value

Analyte	Analytical Method	Soil and Solid Reporting Limit (µg/kg) ¹	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
2-Methylnaphthalene	EPA 8270	133.34	20.2	2	4.7
Naphthalene	EPA 8270	133.34	176	2	12
2-Nitroaniline	EPA 8270	333.34	No Value	5	No Value
3-Nitroaniline	EPA 8270	333.34	No Value	5	No Value
4-Nitroaniline	EPA 8270	333.34	No Value	5	No Value
Nitrobenzene	EPA 8270	133.34	145	2	220
2-Nitrophenol	EPA 8270	666.67	No Value	10	73
4-Nitrophenol	EPA 8270	666.67	13.3	10	58
Nitrosodi-n-butylamine	EPA 8270	666.67	No Value	10	No Value
n-Nitrosodimethylamine	EPA 8270	133.34	No Value	2	25
n-Nitrosodiphenylamine/Diphenylamine	EPA 8270	133.34	22.8	2	No Value
Nitrosodipiperidine	EPA 8270	2000	No Value	20	No Value
n-Nitrosodi-n-propylamine	EPA 8270	333.34	No Value	5	No Value
Pentachlorobenzene	EPA 8270	1333.34	No Value	20	No Value
Pentachloronitrobenzene	EPA 8270	150	No Value	10	No Value
Pentachlorophenol	EPA 8270	666.67	23,000	10	4
Phenanthrene	EPA 8270	133.34	200	2	2.3
Phenol	EPA 8270	333.34	49.1	5	160
Pyrene	EPA 8270	133.34	195	2	0.3
Pyridine	EPA 8270	666.67	106	5	No Value
1,2,4,5-Tetrachlorobenzene	EPA 8270	666.67	1252	10	No Value
1,2,4-Trichlorobenzene	EPA 8270	333.34	5062	5	30

Analyte	Analytical Method	Soil and Solid Reporting Limit (µg/kg)¹	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
2,4,5-Trichlorophenol	EPA 8270	333.34	No Value	5	1.9
2,4,6-Trichlorophenol	EPA 8270	333.34	208	5	4.9
2,3,4,6-Tetrachlorophenol	EPA 8270	166.66	129	5	No Value
m-Toluidine	EPA 8270	300	No Value	5	No Value

Analyte	Analytical Method	Soil and Solid Reporting Limit (µg/kg) ¹	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
PAHs (list)	EPA 8270 (M)				
Acenaphthene	EPA 8270 (M)	6.67	6.71	0.2	13
Acenaphthylene	EPA 8270 (M)	6.67	5.87	0.2	15
Anthracene	EPA 8270 (M)	6.67	57	0.2	0.002
Benzo(a)anthracene	EPA 8270 (M)	6.67	108	0.05	0.025
Benzo(b)fluoranthene	EPA 8270 (M)	6.67	10,400	0.05	2.6
Benzo(k)fluoranthene	EPA 8270 (M)	6.67	240	0.2	0.64
Benzo(ghi)perylene	EPA 8270 (M)	6.67	170	0.2	0.44
Benzo(a)pyrene	EPA 8270 (M)	6.67	140	0.1	0.014
2-Chloronaphthalene	EPA 8270 (M)	6.67	417	0.2	0.396
Chrysene	EPA 8270 (M)	6.67	166	0.2	4.7
Dibenzo(a,h)anthracene	EPA 8270 (M)	6.67	33	0.2	0.28
Fluoranthene	EPA 8270 (M)	6.67	420	0.2	0.8
Fluorene	EPA 8270 (M)	6.67	77	0.2	19
Indeno(1,2,3-cd)pyrene	EPA 8270 (M)	6.67	200	0.2	0.28
1-Methylnaphthalene	EPA 8270 (M)	6.67	130	0.2	No Value
2-Methylnaphthalene	EPA 8270 (M)	6.67	20.2	0.2	4.7
Naphthalene	EPA 8270 (M)	6.67	176	0.2	12
Phenanthrene	EPA 8270 (M)	6.67	200	0.2	2.3
Pyrene	EPA 8270 (M)	6.67	195	0.2	0.3
Hexachlorobenzene	EPA 8270 (M)	6.67	20	0.02	0.0003
Hexachlorobutadiene	EPA 8270 (M)	6.67	26.5	0.2	0.053

Analyte	Analytical Method	Soil and Solid Reporting Limit (µg/kg) ¹	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit (µg/L)	SLERA Selected Surface Water Benchmark (µg/L)
Pentachlorophenol	EPA 8270 (M)	26	23,000	0.3	4
Hexachloroethane	EPA 8270 (M)	6.67	584	0.8	12
Bis(2-ethylhexyl)phthalate	EPA 8270 (M)	NA	182	1.0	0.3
4,6-Dinitro-o-cresol	EPA 8270 (M)	NA	No Value	1.0	No Value
Bis (2-chloroethyl)ether	EPA 8270 (M)	33.3	3520	0.1	19,000
n-Nitrosodi-n-propylamine	EPA 8270 (M)	33.3	No Value	0.1	No Value

Analyte	Analytical Method	Soil and Solid Reporting Limit (mg/kg) ¹	SLERA Selected Sediment Benchmark (mg/kg)	Aqueous Reporting Limit (mg/L)	SLERA Selected Surface Water Benchmark (mg/L)
Metals (list)	SW846 6010				
Aluminum	SW846 6010	4.0	No Value	0.10	0.087
Antimony	SW846 6010	2.0	No Value	0.05	0.08
Arsenic	SW846 6010	0.40	6	0.005	0.148
Barium	SW846 6010	0.40	No Value	0.01	0.004
Beryllium	SW846 6010	0.20	No Value	0.005	0.00066
Boron	SW846 6010	1.2	No Value	0.03	0.0016
Cadmium	SW846 6010	0.40	0.6	0.005	0.00015
Calcium	SW846 6010	4.0	No Value	0.10	No Value
Chromium	SW846 6010	0.40	26	0.01	0.042
Cobalt	SW846 6010	0.80	50,000	0.02	0.023
Copper	SW846 6010	0.40	16	0.01	0.00158
Iron	SW846 6010	2.0	No Value	0.05	1
Lead	SW846 6010	2.0	31	0.01	0.00117
Magnesium	SW846 6010	4.0	No Value	0.10	No Value
Manganese	SW846 6010	0.40	No Value	0.01	0.12
Mercury	SW846 245.1/ SW846 7471	0.005	0.174	0.0002	0.0000013
Molybdenum	SW846 6010	2.0	No Value	0.05	0.37
Nickel	SW846 6010	1.0	16	0.025	0.0289
Potassium	SW846 6010	100	No Value	2.5	No Value
Sulfur	SW846 6010	10	No Value	0.25	No Value
Selenium	SW846 6010	0.80	No Value	0.01	0.005

Analyte	Analytical Method	Soil and Solid Reporting Limit (mg/kg) ¹	SLERA Selected Sediment Benchmark (mg/kg)	Aqueous Reporting Limit (mg/L)	SLERA Selected Surface Water Benchmark (mg/L)
Silicon	SW846 6010	20	No Value	0.50	No Value
Silver	SW846 6010	0.40	0.5	0.007	0.00006
Sodium	SW846 6010	80	No Value	2.0	No Value
Strontium	SW846 6010	2.0	No Value	0.01	1.5
Thallium	SW846 6010	0.80	No Value	0.02	0.006
Tin	SW846 6010	4.0	No Value	0.05	0.073
Titanium	SW846 6010	0.40	No Value	0.01	No Value
Vanadium	SW846 6010	0.40	No Value	0.01	0.012
Zinc	SW846 6010	2.0	120	0.05	0.0657
Other Parameters					
Cyanide	SW846 9010C/ SV846 9012B	1.0	0.0001	0.005	No Value
Total Organic Carbon	SW846 9060A	100	No Value	NA	No Value

Analyte	Analytical Method	Soil and Solid Matrix Reporting Limit ² (µg/kg)	SLERA Selected Sediment Benchmark (µg/kg)	Aqueous Reporting Limit ² (ng/L)	SLERA Selected Surface Water Benchmark (ng/L)
PCBs(homologs)	PCB Homologs				
Monochlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
Dichlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
Trichlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
Tetrachlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
Pentachlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
Hexachlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
Heptachlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
Octachlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
Nonachlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
Decachlorobiphenyl	PCB Homologs	0.033-200	No Value	0.5-500	No Value
PCBs (Aroclors)	EPA 8082A		No Value		No Value
Aroclor 1016	EPA 8082A	33.3	No Value	250	No Value
Aroclor 1221	EPA 8082A	33.3	No Value	250	No Value
Aroclor 1232	EPA 8082A	33.3	No Value	250	No Value
Aroclor 1242	EPA 8082A	33.3	No Value	250	No Value
Aroclor 1248	EPA 8082A	33.3	No Value	250	No Value
Aroclor 1254	EPA 8082A	33.3	No Value	250	No Value
Aroclor 1260	EPA 8082A	33.3	No Value	250	No Value
Aroclor 1262	EPA 8082A	33.3	No Value	250	No Value
Aroclor 1268	EPA 8082A	33.3	No Value	250	No Value
Total PCBs			59.8		0.074

1. Soil reporting limits presented are based on dry weight. Sediment moisture will increase the reporting limits in proportion to the percent moisture and will vary from sample to sample. Sediment samples collected in 2011 ranged from 14% to 86% solids with an average of 40% solids (a sediment sample at 40% solids would increase the soil reporting limit value by 150%).
2. The detection limit for Homolog groups is equal to the lowest detection limit of the individual congener detected within that group. Detection limits will vary with the individual sample matrix, sample preparation procedures, instrument calibration range, and volume of sample analyzed.

Form L: Analytical Precision and Accuracy (Continued)

Analyte	Analytical Method	Precision Objectives (RPD)	Accuracy Objectives (% Rec.)
VOCs	EPA 8260C	Lab Duplicates RPD<25% (All Compounds)	Internal Standards 50-200 % Rec. Fluorobenzene Chlorobenzene-d ₅ 1,4-Dichlorobenzene-d ₄ MS Tuning (4-Bromofluorobenzene) Ion abundance criteria per SOP
Volatile Petroleum Hydrocarbons	Mass VPH	Lab Duplicates RPD<25% (All Compounds)	Analysis of seven LCS samples; Mean concentration ± 30% of true value
Extractable Petroleum Hydrocarbons	Mass EPH	Lab Duplicates RPD<25% (All Compounds)	Analysis of seven LCS samples; Mean concentration ± 40% of true value
SVOCs	EPA 8270	Not Applicable	Internal Standards Nitrobenzene-d ₆ 23-120% Rec. 2-Fluorobiphenyl 15-120% Rec. (w) 30-120% Rec. (s) p-Terphenyl-d ₁₄ 41-149% Rec. (w) 18-120% Rec. (s) Phenol-d ₈ 10-120% Rec. 2-Fluorophenol 21-120% Rec. (w) 25-120% Rec. (s) 2,4,6-Tribromophenol 10-120% Rec. (w) 30-136% Rec. (s) MS Tuning (Decafluorotriphenylphosphine) Ion abundance criteria per SOP
PCBs	PCB Homologs	Lab Duplicates RPD<30% (All Compounds)	LCS/LCSD Spike 40-140% Rec. 30% RPD
	PCB Aroclors	Lab Duplicates RPD<30% (All Compounds)	LCS/LCSD Spike 40-140% Rec. 30% RPD aqueous; 50% RPD soil
Metals	6010C/ 7471B/ EPA 245.1	Lab Duplicates RPD<20% (All Compounds)	LCS 80-120% Rec. (w) For mercury 85-115% Rec. Recovery analyte specific for sediment per SOP.
AVS-SEM	EPA 821-R-91-100 and AVSSEM SOP v2.0	Lab Duplicates RPD<20%	LCS 85-115% Rec.
Cyanide	9010C/ 9012B	Lab Duplicates RPD<20% (w) RPD<35% (s)	LCS 90-110% Rec. LCSD 20% RPD (w) 35% RPD (s)
TOC	9060A	Lab Duplicates RPD<25%	LCS 75-125% Rec.

Form M: Field Quality Control Requirements

QC Sample	Frequency	Acceptance Criteria	Corrective Action
Field Duplicate	1 per matrix or at a rate of 10% (whichever is greater) per sampling event	Per EPA Data validation guidelines for comparison of field duplicates	Compare to appropriate action level and determine need for resampling or re-analysis.
VOC and/or VPH Trip Blank	1 per sampling event (sediment and surface water only)	<Reporting Limit	Evaluate system for possible sources of contamination and reanalyze blank.
Matrix Spike and/or Matrix Spike Duplicates	1 per 20 samples (sediment and surface water only)	Spike recovery must be between 70 and 130% (analyte dependent)	MS/MSD may be analyzed a second time, if failure occurs instrument must be recalibrated.
Equipment Blank	1 per piece of equipment decontaminated in the field per event	<Reporting Limit	Evaluate system for improvement of decontamination procedures and reanalyze blank.

N/A – Not Applicable

Table M (Continued): Laboratory Quality Control Requirements

QC Sample	Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Standard	Daily	<Reporting Limit	Evaluate system for possible sources of contamination and reanalyze blank.
Laboratory Method Blank	Daily	<Reporting Limit	Evaluate system for possible sources of contamination and reanalyze blank.
Laboratory Control Spike	Per Batch	<p>Spike recovery must be between 70 and 130% for VPH and VOCs)</p> <p>Spike recovery must be between 40 and 140% for PCBs and EPH (except for nonane which must be between 30 and 140%)</p> <p>Spike recovery must be between 90 and 110% for cyanide</p> <p>SVOC recovery based on in-house control limits</p>	LCS may be analyzed a second time, if failure occurs instrument must be recalibrated.
Laboratory Duplicate	Per Batch	<p>≤25 RPD for VOCs, VPH, EPH, TOC</p> <p>≤20 RPD for metals, AVS-SEM, CN</p> <p>≤30 RPD for PCBs</p>	Sample analysis must be repeated.
Laboratory Control Spike Duplicate	Analyzed only upon client request (required as part of SVOC and cyanide methods)	<p>Spike recovery must be between 70 and 130% for VPH and VOCs)</p> <p>Spike recovery must be between 40 and 140% for PCBs and EPH (except for nonane which must be between 30 and 140%)</p> <p>Spike recovery must be between 90 and 110% for cyanide</p> <p>SVOC recovery based on in-house control limits</p>	LCS may be analyzed a second time, if failure occurs instrument must be recalibrated.

Form N: Data Management and Documentation

Field Log Book Records

All information pertinent to sampling (including instrument calibration data) will be recorded in a logbook. This book will be bound, preferably with consecutively numbered pages. Entries in the logbook will be made in blue or black ink and will include, at a minimum, a description of all activities, individuals involved (sampling and oversight), date and time of sampling, weather conditions, any problems, and all field measurements.

Sufficient information will be recorded during the sampling trip to permit reconstruction of the sampling without reliance on the collector's memory. Shelf life, lot numbers, manufacturer, and expiration dates of calibration gas used for calibration of field instrumentation will be recorded.

Laboratory Data Package Deliverables

The data packages from the analytical chemistry laboratories will consist of full deliverables, including all QC and a summary or narrative of any deviation from the QC criteria as well as observations about the samples.

The following deliverables will not be required, but will be maintained by the laboratory and may be requested at a later date:

- Chromatograms
- Copies of Instrument logbooks
- Copies of internal chains of custody

Form O: Assessment and Response Actions

Any deficiencies or problems encountered during this investigation require corrective action. The project QA Officer will be notified immediately if any problems are encountered in the field. Minor adjustments to the sampling design may proceed with notification of the project QA Officer and documentation in the field notebook.

The project manager and project QA officer will be responsible for identifying and reporting any deficiencies or problems. Any problems or deficiencies reported by telephone or in person to the QA officer will be documented on a telephone/personal conversation report form. Any problems or deficiencies reported in the field will be documented in the field notebook. Any corrective actions required will be documented in the field notebook.

Immediate Corrective Action: Corrective action for analytical work will include recalibration of instruments, reanalysis of known QC samples and, if necessary, of actual field samples. Specific QC procedures and checklists will be in use by the analytical laboratory, designed to help analysts detect the need for corrective action. Often the person's experience will be valuable in alerting the operator to suspicious data or malfunctioning equipment.

If an immediate corrective action can be taken, as part of normal operating procedures, the collection of poor quality data can be avoided. Instrument and equipment malfunctions are amenable to this type of action and the QC procedures include troubleshooting guides and corrective action suggestions. The actions taken will be noted in field or laboratory notebooks, but no other formal documentation is required, unless further corrective action is necessary. These on-the-spot corrective actions are an everyday part of the QA/QC system.

Corrective action during the field sampling portion of a program is most often a result of equipment failure or an operator oversight and may require recollection of a sample. Every effort will be made by the Field Team Leader to ensure that all QC procedures are followed.

Form P: Project Reports

The work conducted for this program will be presented in summary reports prepared by FSL containing figures and tables depicting Site conditions, and recommendations for further actions. The text will be supported by analytical data, summary tables, and figures showing exploration locations, and contaminant distribution, as appropriate. The reports will include a statement regarding data quality and the impact of data problems on the usability of the data. This will include quality problems found and corrective actions taken.

Form Q: Data Evaluation

Verification of Sampling Procedures

The sampling procedures will be recorded in the field on the designated field data sheets, and/or field notebook. The field data sheet will be reviewed to ensure the following information is properly documented:

- Sample identification;
- Source;
- Date and time of sampling;
- Sampling equipment;
- Sampler(s); and
- Results of any field monitoring or observations.

The sample handling procedures for each sample will be recorded on the chain-of-custody form. The chain-of-custody form will be reviewed to ensure the following information is properly documented:

- Sample identification;
- Number, type and size of sample containers;
- Start and end times of air sample collection; and
- Signatures.

The review will be performed by the QA officer.

Data Verification and Validation

FSL will ensure that deliverables from the laboratory will be sufficient for data validation at another date, if needed. The data packages will be reviewed for completeness.

Validation may be performed on the data but will be limited to holding times and QC results, as summarized on forms from the laboratory. A memo summarizing the results of the validation will be included in the report.

Form R: Data Usability

Evaluation of data usability will be based on a review of the data verification and DQO.

The matrix and/or interference may require a dilution, which increases the reporting limits (RLs). The RLs will be evaluated to determine that concentrations above the guidance levels are reported. If the RL exceeds the guidance criterion, then the concentration will be assumed to exceed the guidance criteria unless otherwise documented. If the data usability is limited, the limitations will be discussed in the report.

Results of the data usability assessment will be discussed in the final report for all collected data.

FIGURES

Figure 1	Locus Plan
Figure 2	Site Plan
Figure 3	Approximate Locations of Soil Remediation Areas
Figure 4	Historic Pond Sampling Locations
Figure 5	Pond Bank Characterization Zones
Figure 6	Approximate Sediment and Surface Water Sampling Locations in Lower Shoe Pond
Figure 7	Approximate Sediment and Surface Water Sampling Locations in Upper Shoe Pond
Figure 8	Preliminary Exposure Pathways Diagram